DOMINION OF CANADA
DEPARTMENT OF AGRICULTURE
EXPERIMENTAL FARMS

DIVISION OF ENTOMOLOGY

# FLEA-BEETLES AND THEIR CONTROL

BY

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## NOTE.

All inquiries relating to insect pests, and packages (up to five [illegible] in weight) containing specimens, may be mailed "free" if addressed to the [illegible] Entomologist, Central Experimental Farm, Ottawa.

In all cases where it is possible, living specimens of the insects should be sent inclosed in a strong wooden or tin box to prevent damage in transit. Living insects should be supplied with a liberal quantity of their food plant, and in all cases they should be carefully packed.

The name and address of the sender should be written on the outside of the package, and a letter giving as full details as possible should in all cases accompany insects sent in for report.

# FLEA-BEETLES AND THEIR CONTROL.

By Arthur Gibson, *Chief Assistant Entomologist.*

The Flea-beetles are a small but very important group of beetles which attack the foliage of many plants. They are particularly destructive to several kinds of vegetable crops, such as turnips, potatoes, tomatoes, radishes, etc., and every season more or less numerous complaints are made of their injuries. The beetles are closely related and all belong to the same family of Coleoptera viz., the Chrysomelidæ, the members of which are known commonly as the "leaf-beetles." In Canada there are five species of flea-beetles which are of considerable economic importance. Other kinds occasionally appear in destructive numbers, but their injuries, as a rule, are not of a serious nature.

## APPEARANCE OF FLEA-BEETLES AND NATURE OF THEIR INJURIES.

The several kinds of flea-beetles which are destructive in Canada, vary considerably in size and colour. In general, they may be described as either yellowish, brownish, bluish, greyish, purplish or black, shining beetles of an oval-elongate shape, and having the upper joint of the hind legs largely developed which enables them to leap suddenly and owing to which jumping habit they were given the popular name of flea-beetles. In size they range from about $\frac{1}{10}$ to $\frac{1}{4}$ of an inch in length.

The flea-beetles are most injurious in spring, at which time the young seed leaves of such plants as turnips, radishes, etc., are visited by large numbers of the adult insects and quickly destroyed. Numerous small holes, in some of the larger leaves as many as several hundreds, are eaten into and through the leaves; in fact large portions of the foliage are often completely eaten, the larger veins only remaining. This latter more or less complete defoliation is effected by the larvæ of such species as the Grape Vine Flea-beetle. Injury is also inflicted on the plants by the larvæ, or grubs, of at least one species, which feed upon the roots of vegetables, and at Ottawa, the leaves of curled cress have been mined by larvæ of the Turnip Flea-beetle. As a rule, however, little injury is done by the larvæ to such crops.

Fig. 1.—Characteristic work of Flea-beetles; (original).

## METHODS OF CONTROL.

*Arsenicals and Bordeaux mixture.*—The usual remedy for the protection of crops against the ravages of flea-beetles, particularly the larger species, is to spray the plants with an arsenical mixture containing either Paris green or arsenate of lead, or with the ordinary Bordeaux mixture alone. The latter acts as a deterrent. For most plants, Paris green may be used in the proportion of ¼ of a pound to 40 gallons of water, with ¼ of a pound of freshly-slaked lime. Such plants as have coarse foliage, as the potato, will stand double this strength of Paris green. Arsenate of lead which has now come into such wide use may be used in the proportion of from two to three pounds to 40 gallons of water. Both of these arsenicals may be applied in the above strengths in combination with Bordeaux mixture.

In the case of the Potato Flea-beetle, in experiments conducted at Ottawa, the Bordeaux mixture used alone gave satisfactory results. When the beetles are present in excessive numbers, it may be necessary to spray at least twice a week or even every third day in order to get satisfactory results. Paris green dry is also a good remedy and may be used with land plaster, in the proportion of one pound of the Paris green to twenty pounds of the land plaster. This mixture should be dusted upon the plants, preferably in the early morning when they are covered with dew. The land plaster stimulates the plants and hastens their growth, while at the same time the Paris green kills the beetles. The Turnip Flea-beetle especially is easily controlled by this remedy which should be applied early in the season, before the seed leaves, so important to the young plants, are destroyed. When flea-beetles, or other leaf-eating insects are found attacking cabbages, it is inadvisable to use arsenical mixtures after the heads of the plants are half formed. In spraying such plants, the mixture will adhere better if a "sticker" is added. Such can be made by boiling together for about an hour, 2 pounds of resin and 1 pound of sal soda (crystals) in a gallon of water. This is sufficient for 40 gallons and, if used with Paris green a pound of fresh lime should be added.

When setting out such plants as tomatoes, protection from flea-beetle attack may be obtained by dipping them, except the roots, in a mixture of arsenate of lead, using one pound in 10 gallons of water.

*Cheese cloth covers.*—In our experiments in screening beds of radishes, etc., in the control of root maggots, the protected plants were kept free of the attacks of flea-beetles in addition to the root maggots. Such a method of protecting plants from insect attack is of considerable value. Barrel hoops cut in two and the ends inserted in the ground make a cheap frame upon which the cheese cloth can be spread, the sides of which touching the ground should be covered with earth to close up all entrances which might admit the beetles. In New York State, W. J. Schoene * recommends frames made with six or eight inch boards with galvanized wires four or five feet apart upon which to spread the cheese cloth. The wires may be supported on stakes and held in place by small staples. The boards may be secured by stakes driven into the ground on either side.

*Whale-oil Soap and Kerosene Emulsion.*—In British Columbia, gratifying results were obtained in 1909 in destroying the Hop Flea-beetle by spraying hop vines with whale-oil soap in the proportion of one pound of soap to five gallons of water. In years when the beetles are abundant, however, regular treatments of such a quick-growing crop with a soap mixture are practically prohibited, on account of cost and labour, as such would have to be applied every twenty-four hours. Kerosene emulsion has also been used for the destruction of the adults of the Hop Flea-beetle, but, like whale-oil soap, this only kills when it comes into actual contact with the insects.

*Bull. No. 334, N.Y. Agr. Exp. Stn., Geneva, Feb. 1911.

*Tarred sheets and other adhesive traps.*—In localities where the Hop Flea-beetle is a serious pest, sheets or boards coated with tar have been used with much success. These are placed under the hop vines which are jarred lightly with a branch or stick thus causing the beetles to fall off and adhere to the tar. A large feather duster is useful for dislodging the beetles. W. B. Parker* recommends banding the vines with tanglefoot after they are trained, the bands to be placed about two feet from the ground. New bands will be necessary whenever the beetles are entrapped in sufficient numbers to form a bridge over which others can crawl. Trellis poles should also be banded.

*Late Sowing.*—In the case of the Turnip Flea-beetle, Fletcher states in Bulletin No. 52 of the Experimental Farms, that careful observation has shown that, for central Ontario, the third week in June is the most satisfactory time for sowing turnips to avoid injury by the beetles. By that time the perfect insects of the first brood have, as a rule, disappeared, and the young plants grow rapidly and produce as good crops as when sown three weeks earlier.

*Clean Culture.*—In view of the fact that flea-beetles in the larval state feed upon the roots of common weeds such as the nightshades, thorn apple, lamb's quarters, pigweed, ragweed, etc., it is important that such weeds be pulled and burned. If this is done about the middle of July, large numbers of the grubs will be destroyed. Weeds along margins of fields, of course, should be kept down. It is a wise practice to use land infested by such weeds for crops which are not attacked by the adult flea-beetles.

It is also important to remove from fields and gardens in the fall all remnants ofcrops, such as cabbage stumps, leaves and tops of turnips, etc. and other refuse which would serve as hibernating shelters for the adult flea-beetles. All such refuse should be either ploughed deeply or carefully gathered up in piles and burned.

## THE COMMONER SPECIES OF FLEA-BEETLES.

### The Spinach Flea-beetle, (*Disonycha xanthomelæna* Dalm.)

As yet, little injury has been done to cultivated crops in Canada by this insect. In some seasons the beetle, which is nearly one-quarter of an inch in length and in colour black with a yellowish thorax, is fairly abundant in Ontario and Quebec, but no serious complaints have as yet been received of its work on spinach or beets, the crops chiefly attacked in the United States. At Ottawa we have found the beetles in May, June, September and October. The insect feeds naturally on lamb's quarters, chickweed and probably other closely related plants.

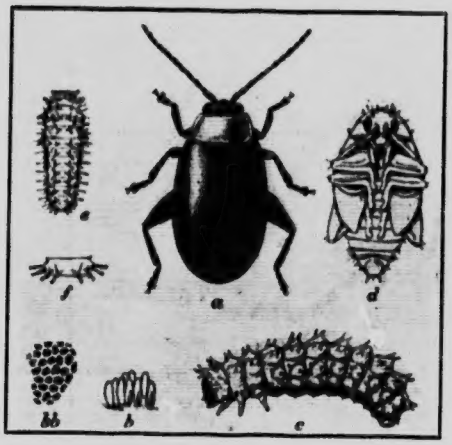


Fig. 2.—Spinach Flea-beetle: *a*, adult beetle; *b*, egg mass; *bb*, sculpture of egg; *c*, full grown grub; *d*, pupa; *e*, newly hatched grub; *f*, abdominal segment of same; *a*, *c*, *d*, five times natural size; *b*, *e*, more enlarged; *bb*, *f*, still more enlarged. (After Chittenden, Bull 19, N.S., Div. of Ent., U.S. Dept. Agr.)

### The Triangle Flea-beetle.

(*Disonycha triangularis*) Say.

Some years this flea-beetle is destructive in Ohio, Michigan and elsewhere in the United States particularly to beets. The insect is common in Canada and on several

*Bull. 82, Part IV. U.S. Bureau of Entomology.

occasions, we have had it sent in from Manitoba where it occurred in wheat fields, but no actual injury to this plant was detected.

This species is very similar in appearance to the Spinach Flea-beetle but is slightly larger and has three small dots on the yellowish thorax.

FIG. 3.—Thorax of Triangle Flea-beetle, showing position of spots; much enlarged; (original).

### THE ALDER FLEA-BEETLE, (*Haltica bimarginata* Say.)

Occasional records have been received of injury by this beetle to alder, poplar and willow. It is of widespread occurrence throughout Canada, specimens having been found in Nova Scotia in the east and British Columbia in the west, and as far north as Fort Simpson on the McKenzie River. Large numbers of the beetles were found feeding on willows, in 1898, at Red Deer, Alta. In length the beetle is about one-fifth of an inch and of a purplish-blue colour.

FIG. 4.—Alder Flea-beetle; enlarged 4½ times; (original).

### THE GRAPE VINE FLEA-BEETLE, (*Haltica chalybea* Ill.)

The tender buds of grape vines are often completely eaten by swarms of these flea-beetles which leave their winter quarters early in spring. The injury may even, occasionally, cause the death of the vines. In Ontario, grape growers in some sections have suffered considerably from the attack of this beetle which is one-fifth of an inch long, varying in colour from a steel-blue to green. The female beetle begins to deposit its oval shaped, yellowish eggs early in the season. These may be laid in cracks of the bark at the base of the bud, in cavities where the beetles had eaten into a bud, or even upon the foliage. About

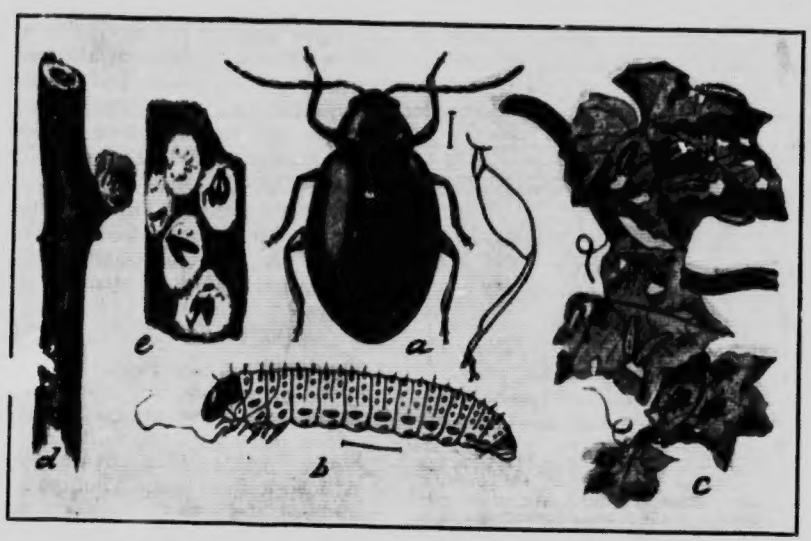


FIG. 5.—The Grape-vine Flea-beetle; *a*, adult enlarged 7 times, hind leg enlarged at right; *b*, grub enlarged 6 times; *c*, grubs and beetles on foliage—natural size; *d*, beetle feeding on bud; *e*, diseased beetles. (After Marlatt, U.S. Dept. Agr.)

the time the leaves have expanded, the young grubs hatch and eat out irregular holes becoming full-grown in three or four weeks, at which time they are one-third of an inch long and of a dirty yellowish-brown colour with black, shining, bristle-bearing tubercles. When mature, the grubs drop to the ground and enter the earth to change to the pupal state, and in a week or two the beetles emerge. As these beetles pass the winter in the perfect state beneath dead leaves and other rubbish, it is important that all such refuse be gathered up and burned in autumn so as to reduce as much as possible the opportunities for these insects to hibernate near the vines. Grape growers should watch for the appearance of these insects when the buds are forming, and when they are detected, a strong spray of either Paris green or arsenate of lead should be applied to the vines so that every bud will be literally soaked. The buds will stand as strong a dose of Paris green as one pound in 75 gallons of water, with an equal amount of freshly-slaked lime added. In a few days, the application should be renewed, or sooner if the first treatment is washed off by rain. Arsenate of lead is recommended as strong as eight pounds to the barrel of water. In small gardens, the practice of jarring the beetles from the vines into an inverted umbrella and then destroying them into a pan containing coal oil and water, is of value. When the grubs are found feeding on the leaves, spraying with Paris green or arsenate of lead in the ordinary strengths (one pound of Paris green to 160 gallons of water, or arsenate of lead 2 pounds in 40 gallons of water) will give relief. The destruction of the grubs is an important factor in the control of this insect, because every grub killed means one beetle less the following spring to attack the buds. In addition to grapes, the Grape vine Flea-beetle commonly attacks Virginia creeper.

### The Strawberry Flea-Beetle (*Haltica ignita* Ill.)

This flea-beetle, also known as the Fiery Flea-beetle and the Lesser Grape Vine Flea-beetle, has in the United States seriously attacked the leaves of strawberries, and injury has also been done to grape and peach.

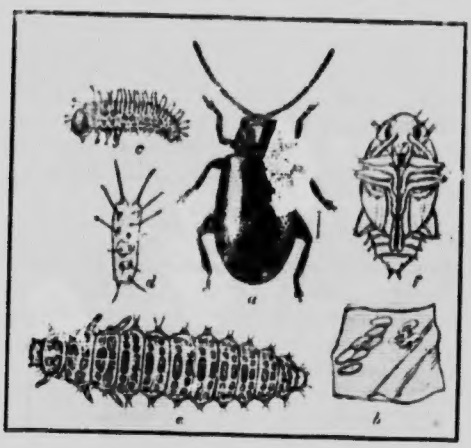

Fig. 6.—Strawberry Flea-beetle: *a*, adult; *b*, eggs on leaf; *c*, newly hatched grub; *d*, first abdominal segment of same greatly enlarged; *e*, grub; *f*, pupa —all except *d* about 8 times natural size. (After Chittenden, Bull. 23, N.S., Div. of Ent., U.S. Dept. Agr.)

In 1910, specimens of a flea-beetle were received from Nelson, B.C. with a report that it was attacking freely the foliage of strawberries. The beetle was determined at the time as *Haltica ignita* Ill. and referred to under this name in the Report of the Dominion Entomologist for the year ending March 31, 1911. The species however, is *Haltica evicta* Lec. The only record of injury in Canada which has come to our notice by *Haltica ignita* * was in 1910 when the beetles were very numerous at St. Stephen, N.B., and other places nearby, doing very noticeable damage to the foliage of elm. The beetle is variable in colouration, some specimens being bronzy or purplish, others decidedly greenish or bluish. In length it is about one-eighth of an inch.

* A specimen of this beetle was examined by Mr. H. C. Fall, who reported that he believed it to be very nearly typical *carinata*. *Carinata*, however, as he understands it is not very far removed from *ignita*.

### The Bronze Flea-beetle, (*Haltica evicta* Lec.)

This species of *Haltica* which occurred at Nelson, B.C. in 1910 was abundant on the leaves of strawberry, in the last week of April; 180 specimens were collected from a single plant. It is a larger flea-beetle than *Haltica ignita*, being about one-sixth of an inch in length and of a bronze colour. The outbreak of 1910 is the only definite record we have of injury by this beetle. In the report of the Dominion Entomologist for the year ending March 31, 1911, it is stated that *Haltica evicta* was very destructive to turnips and cabbages at Half Way Lake, Alta. Upon further study, however, we find that the species is certainly not *evicta*, but that it is at least closely allied to *ignita* in which the ante-basal groove of the thorax is deep and continuous.

Fig. 7.—The Bronze Flea-beetle, enlarged 4 times; (original).

### The Potato Flea-beetle, (*Epitrix cucumeris* Harr.)

One of the most destructive of the flea-beetles which occur in Canada is the Potato Flea-beetle, a very small species, measuring from about one-sixteenth of an inch to one-twelfth of an inch in length, black in colour with pale-reddish legs. The foliage of potato and tomato are freely attacked by the beetles, which eat numerous small holes in the leaves. In addition, the beetles have been found feeding upon cabbages, cucumbers, beans, tobacco, squashes, pumpkins, wonderberry and other plants. As a rule the insect is more numerous in hot dry seasons. Many reports of injury have been received from Ontario and the eastern provinces as well as from as far west as Vancouver Island, B.C. The beetles pass the winter in dry sheltered spots and make their appearance early in spring; the females soon deposit their minute eggs upon the roots of common weeds of the Nightshade family, the resulting grubs feeding underground and changing there, when full grown, to the pupal state. The beetles, when they issue, freely attack the leaves of vegetables, largely the foliage of potatoes, and in some years towards the end of July or early in August serious injury is effected. In the spring, the young leaves of such plants as are mentioned above are often entirely eaten by the overwintering beetles.

Fig. 8.—Potato Flea-beetle; line at side indicates natural size. (After Chittenden, Bull. 19, N.S., Div. of Ent., U.S. Dept. Agr.)

### The Red-headed Flea-beetle, (*Systena frontalis* Fab.)

This common flea-beetle, so called from the conspicuous red patch on the top of the head, is jet black in colour and in length about three-sixteenths of an inch. The body is slender and elongated. In Ontario and other eastern provinces the beetles are sometimes extremely numerous. Records of injury at Ottawa indicate that the insect has a very wide range of feeding plants. It has been particularly destructive early in the season to the foliage of potatoes, beans and young grapes, as well as to many kinds of deciduous shrubs. Large numbers of the beetles have been found feeding upon flowering plants in gardens such as marsh mallows, rose mallows and Japanese honeysuckles. Both at Ottawa and Guelph, Ont. damage has been done to clover in August. During 1912, the beetles were present in exceptional numbers, at Bryanston, Middlesex County, Ont., in corn fields, but the chief injury was to the mangel-wurzel; on one farm a two-acre crop of mangels was badly infested, the leaves being riddled and practically destroyed.

Fig. 9.—Red-headed Flea-beetle, enlarged 5 times; (After Chittenden, Bull. 33, N.S., Div. of Ent., U.S. Dept. Agr.).

### The Black Margined Flea-beetle, (*Systena marginata* Ill.)

Occasionally in eastern Canada outbreaks of this insect have appeared in the middle of the summer, considerable injury to certain forest and shade trees resulting therefrom. At Ottawa, the worst attack has been in August, when the beetles appeared in large numbers feeding chiefly on elm, oak and hickory. In one outbreak, the leaves of the Service Berry (*Amelanchier canadensis*) were freely eaten, in fact on some of the branches only the ribs of leaves remained. This flea-beetle is from ¼ to about $\frac{3}{16}$ inch. long, yellowish-brown in colour with the thorax and wing-cases margined with black along the outer edge. The latest date on which the writer has found the adults feeding is September 15, (on oak).

### The Pale-striped Flea-beetle, (*Systena blanda* Mels.)

In the United States, this flea-beetle, which is about one-eighth of an inch long, pale brown with a cream-coloured band on each wing-case and a reddish head, has often required control measures owing to its injuries to the foliage of such plants as corn, strawberry, melon, potato, carrot, beet, clover, etc. Few records only, however, are available of important injury by the adults of this beetle in Canada. In the county of Wentworth, Ont., some years ago, turnips, pumpkins and strawberries were seriously attacked. In some places the beetles were so abundant on pumpkins that the leaves appeared as if they had been sprinkled with ashes. During 1912 the overwintered beetles were found in numbers, in May, in Middlesex County, Ont. in timothy fields but they were not observed feeding. In July, they were noticed in corn fields but were doing little or no injury. Garden beets, beans and occasionally mangels were, however, being eaten.

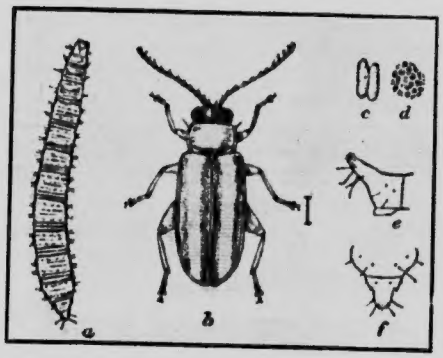


Fig. 10.—Pale-striped Flea-beetle: *a*, grub; *b*, beetle; *c*, eggs; *d*, sculpture of egg; *e*, anal segment of grub, from side; *f*, same from above—*a-d*, 6 times natural size; *e*, *f*, much enlarged. (After Chittenden, Bull. 23, N.S. Div. of Ent., U.S. Dept. Agr.)

### The Turnip Flea-beetle, (*Phyllotreta vittata* Fab.)

This is one of the commonest and most regularly-occurring destructive flea-beetles which attack vegetables. It is, also, sometimes troublesome in flower gardens, attacking foliage of stocks and wall flowers. It is a small species of a shining-black colour and in length about one-sixth of an inch. On each wing-cover there is a wavy band of yellow. The overwintering beetles appear early in the season and in the latter half of May and during June, much injury is done to young radishes, turnips, cabbages and other cruciferous plants. The chief damage is to the seed leaves directly these appear above ground and just when the young plants can least withstand such attack. Later, when the rough, true leaves are formed, the plants, as a rule, are able to make more growth each day than the beetles can destroy. The female beetles deposit their tiny, white, eggs upon the roots of the plants and the young grubs feed thereon oftentimes doing considerable injury; it is probable, however, that this injury is largely confined to weeds belonging to the mustard family.

Fig. 11.—Turnip Flea-beetle enlarged 12 times. (After Riley U.S. Dept. Agr.)

When full-grown, the grub is about three-sixteenths of an inch, slender, of a darkish colour, the body bearing, sparsely, minute hairs. At Ottawa, the grubs have been found feeding in the leaves of curled cress. There are two or three broods during the season and the species occurs generally throughout Canada.

### The Horse Radish Flea-beetle, (*Phyllotreta armoraciæ* Koch.)

In 1893 specimens of this European flea-beetle were found at Chicago, Ill. and since then the insect has been found in other places in the United States and it has also occurred at several points in Canada. The first Canadian record we have is its appearance at Guelph, Ont. in about 1908. In 1910, it was found abundantly at Montreal, on horse radish, the leaves of which had been riddled by the beetle. In 1912, a few specimens were collected at Ottawa, one of these being found on a leaf of garden radish. The only cultivated crop attacked, however, seems to be the horse radish. The beetle is about one-eighth of an inch long, oval in form and, in colour, black with the wing cases pale-yellow excepting an outer edge of black and a wide band of the same colour where the wing-cases join.

Fig. 12.—Horse Radish Flea-beetle, enlarged 9 times. (After Chittenden, Insect Life, Vol. VII.)

### The Hop Flea-beetle, (*Psylliodes punctulata* Melsh.)

Growers of hops in British Columbia have lost large sums of money from the ravages of this small flea-beetle, which is bronze-black in colour and about one-twelfth of an inch in length. The beetles which pass the winter in the trellis poles, under rubbish, etc., on the ground, or just under the surface of the soil, become active in the end of March and during April. There are two distinct broods of this insect in British Columbia. The over-wintered females deposit their egs in spring and the beetles resulting from these mostly appear in early June. The beetles of the second generation appear in the end of July and during August and these latter pass the winter hidden away beneath the rubbish, etc., as above mentioned. In the bulletin on the life-history and control of this flea-beetle, referred to on page 5 it is stated that "the hibernating beetles, unless in unusually large numbers, will not require any attention, but the sudden appearance of the first generation just before the vines are trained may require the use of the tarred board or sticky shield." The tarred board used was made by stretching a piece of 8-ounce canvas over a light wooden frame, 4 feet long by 3 feet wide. A 4-foot strip attached to the middle of the board at a convenient angle and braced by an upright to the rear edge forms a handle. The canvas was then coated with tar. Such a contrivance (Fig. 14) if placed on the leaward side of the vine and the latter brushed with a large feather duster, or cedar bough, will, it is claimed, catch 85 per cent. of the beetles present. After the vines are

Fig. 13.—Hop Flea-beetle: enlarged 12 times; (original).

trained, the beetles can be controlled by the use of tanglefoot bands as mentioned on page 5. In 1909, whale-oil soap was used to a considerable extent

FIG. 14.—Method of using light sticky shield and feather duster in combating the Hop Flea-Beetle. (After Chittenden, Bull. 82, Bureau of Ent., U.S. Dept. of Agr.)

in British Columbia (page 5). In addition to the hop, the Hop Flea-beetle has been found attacking tomato, mangel, radish, rhubarb, potato, etc.